

A review of *Paraloxopsis* Günther, 1932 and a first description of the male and egg of *Paraloxopsis korystes* Günther, 1932.

P.E. Bragg, 8, The Lane, Awwsworth, Nottinghamshire, NG16 2QP, U.K.

Abstract

The genus *Paraloxopsis* Günther, 1932 was described from a single female specimen of *Paraloxopsis korystes* Günther, 1932. The male and egg are described for the first time, along with a redescription, and illustrations, of the female; three new Bornean localities are recorded for this species. *Loxopsis tuberculata* Redtenbacher, 1908 is transferred to *Paraloxopsis*, redescribed, and recorded from five new localities. The key features distinguishing this genus from *Loxopsis* Westwood, 1859 are listed. The mode of egg laying is discussed in relation to other possible related genera.

Key words

Phasmida, Necrosciinae, *Paraloxopsis*, Borneo, Brunei, Kalimantan, Sabah, Sarawak.

Introduction

The genus *Paraloxopsis* Günther, 1932 was described from a single female specimen of *Paraloxopsis korystes* Günther, 1932, which was collected on Mt. Kinabalu, Sabah. Two specimens, one male and one female with eggs, of *Paraloxopsis korystes* Günther, 1932 were located in the collection of C.L. Chan (Kota Kinabalu, Sabah); these were borrowed in order to confirm their identity by direct comparison with the type specimen in Hamburg Museum (ZMUH). Recently two males were sent to me for identification by a PhD student, Ed Turner, at Cambridge University (CUMZ).

In 1993 I received, from Mel Herbert, a photograph of a phasmid collected near Badas in Brunei, along with a note about the eggs. In 1994, accompanied by Mel Herbert and Ian Abercrombie, I collected a female of the same species in an area of drained swamp forest near Badas. The specimen laid five eggs before dying; the egg was illustrated and described as "*Loxopsis* sp." (Bragg, 2001: 565, figs 225a-c). Recent examination has shown the insect belongs in *Paraloxopsis* and the species was originally described as *Loxopsis tuberculata* Redtenbacher, 1908; the material has been compared with a photograph of the type material in Paris Museum (MNHN). Eight more specimens of this species have been located in other collections: Cambridge University Museum (CUMZ), Sarawak Museum (SMSM), Kinabalu Park Conservation Centre, and in the private collection of Francis Seow-Choen in Singapore. In some cases the examination of material was restricted to photographic examination only.

Standard museum codens (Arnett, *et al.*, 1993; <http://hbs.bishopmuseum.org/codens/>) are used below, in addition: PEB indicates a specimen in my personal collection; Kinabalu NP indicates material in Kinabalu National Park Conservation Centre, Sabah; C.L. Chan's collection is in Kota Kinabalu, Sabah.

***Paraloxopsis* Günther, 1932**

Paraloxopsis Günther, 1932: 317; Bragg, 2001: 592.

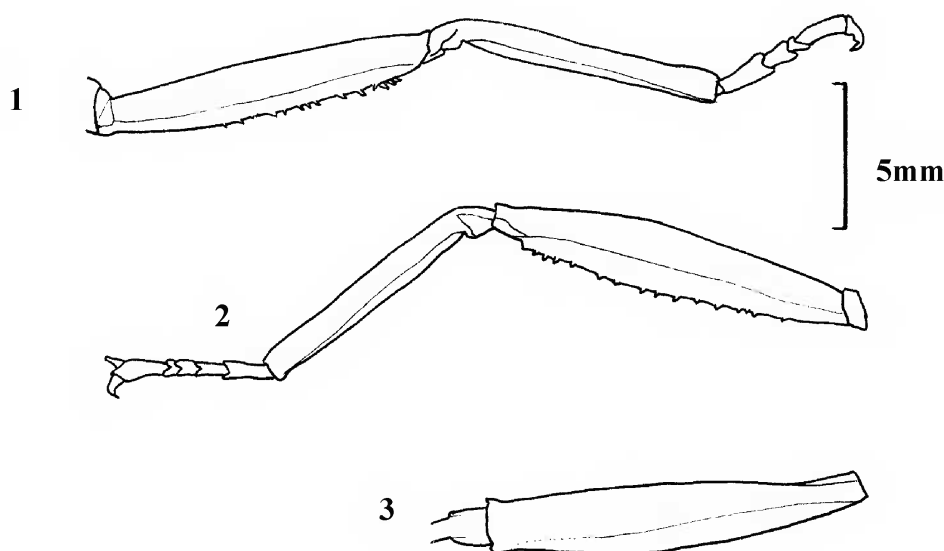
Type species *Paraloxopsis korystes* Günther, 1932, by original designation.

Description of the genus

Body quite robust. Head, thorax, and legs densely granulose. Whole insect uniformly mid brown, or mid brown with cream, greenish-grey or dark brown patches particularly on the legs and costal region of the wings. Head approximately triangular in both lateral and dorsal aspects. Back of the head with an elongated swelling that narrows to a point and projects backwards over the pronotum; head spinose, and may be lobed. Antennae projecting slightly beyond the apices of the forelegs; segments distinct, but less so towards the apex. Mesonotum spinose; female with one or two obvious swellings, with at least the anterior spinose. Tegmina with a very distinct hump. Wings reaching to about the end of 7th abdominal segment. Anal region of wings translucent, with brown veins. Ventrally all femora have a double row of spines at least apically.

Hind legs not reaching the end of the abdomen, or reaching only slightly beyond. Hind femora distinctly swollen. All legs with basal tarsomere less than twice the length of second tarsomere. Operculum of female with a deep apical incision. Anal segment of female with apex straight, male with an apical notch. Cerci cylindrical. The eggs are almost spherical but have a polar spine that is used to pin them to leaves.

Comments: Generally very similar to *Loxopsis* Westwood, 1859, but distinguished by the pointed elongation of the head and by the swollen hind femora; *Loxopsis* have a conical head (but not pointed), and the hind femora are not swollen. Eggs similar in general form to those of *Asceles*. The genus appears to be endemic to Borneo.



Figures 1-3. Hind legs of female *Paraloxopsis tuberculata* (specimen PEB-2300). **1.** Anterior view of left hind leg; the tarsus is four-segmented indicating the leg has been regenerated, the femur is less swollen than is normal in this genus. **2.** Anterior view of right hind leg; the femur showing the normal degree of swelling. **3.** Dorsal view of right femur.

Key to species

- 1. Body and costal region of wings more or less uniformly mid-brown or brown with only one or two broad dark bands, or with some grey bands. Head granulose and spinose, but without lobes. When the insect is viewed laterally the front edge of the tegmina are not concave. Mesonotum of female with two obvious mounds which are evenly spaced on the segment; mesonotum of male spinose mainly at the anterior.
 *Paraloxopsis tuberculata* (Redtenbacher)

- Body and costal region of wings mid brown with lighter (cream) and darker markings. Head with lobes in addition to granules. When viewed laterally, with the wings folded, the tegmina have a concave front edge. Mesonotum of female with one spinose mound at the mid point, the second mound is spineless and on the posterior margin; male with a bispinose mound at the mid point.
 *Paraloxopsis korystes* Günther

***Paraloxopsis korystes* Günther, 1932**

Paraloxopsis korystes Günther, 1932b: 318, fig. 1 (♀); Bragg, 2001: 593; Zompro, 2002: 191.
Holotype ♀ (ZMUH) Sabah, Mt Kinabalu, c. 1500m, coll. Waterstradt.

Material examined

SABAH, Mt Kinabalu, c. 1500m.

Holotype ♀ (ZMUH) coll. Waterstradt.

SABAH, Sepilok Forest Reserve, Orang-utan Research Centre.

♀ & 5 eggs (C.L. Chan) Chan, Wong & Seow, 17.iv.1993.

SABAH, Maliau Basin, Gunung Lotung, 500m.

♂ (C.L. Chan) 18-20.iv.1988, W. Wong.

SABAH, Danum Valley, Primary forest. Fogging experiment, sample: 2 East.

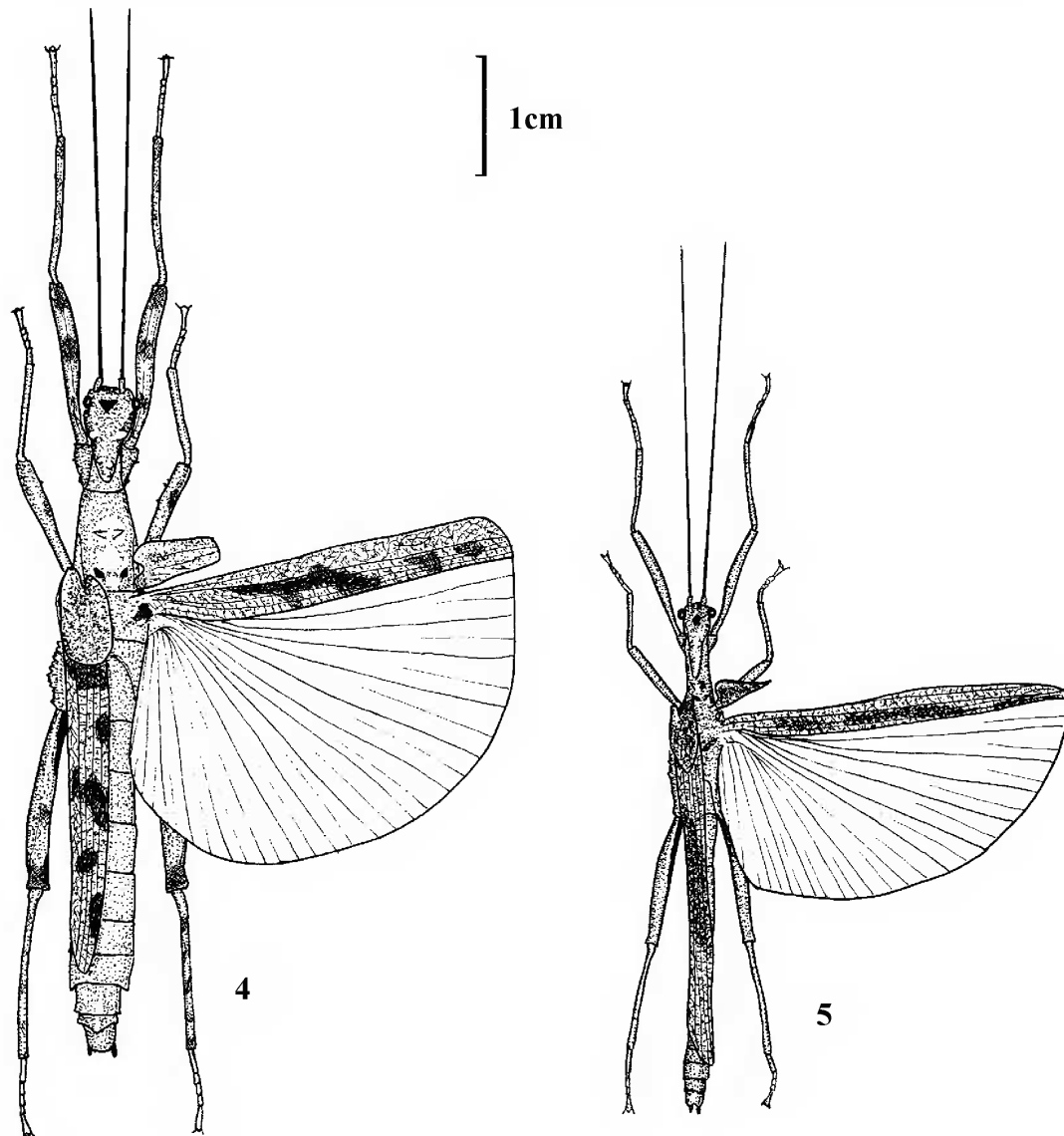
1♂ (CUMZ) Ed Turner, 2002.

SABAH, Danum Valley, Primary forest. Fogging experiment, sample: J East.

1♂ nymph (CUMZ) Ed Turner, 2002.

SARAWAK, Lambir Hills N.P.

1 nymph (Photograph only - specimen not preserved) Robert Junker, 03.iii.2006.



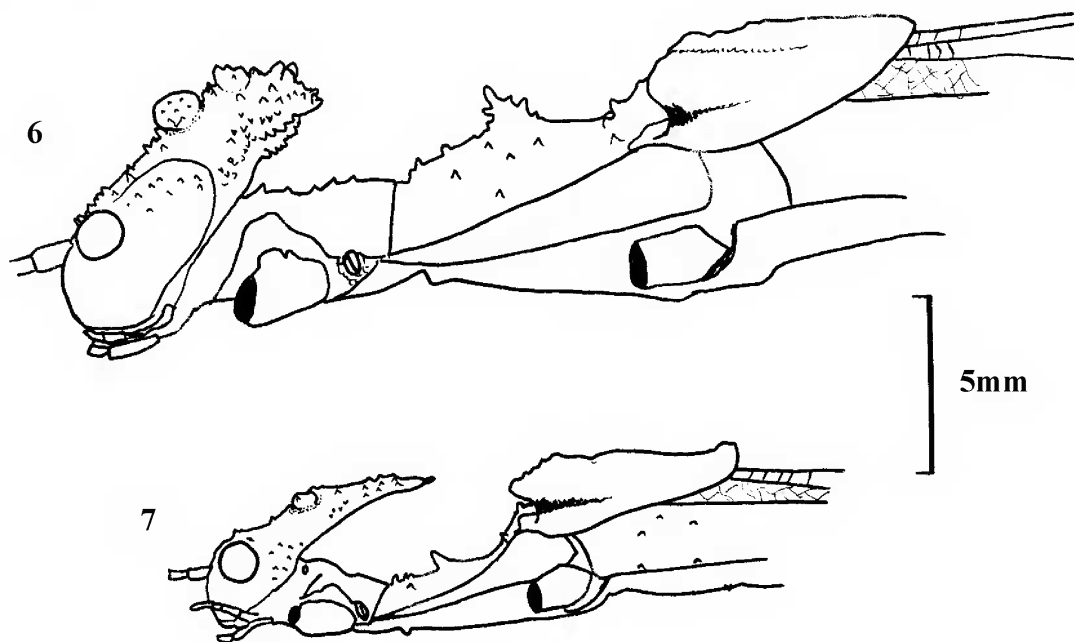
Figures 4-5. *Paraloxopsis korystes*. 4. Female. 5. Male.

Female (figs 4, 6, 8-10)

The following description and the measurements in table 1 are based on C.L. Chan's material only. The spines in the middle of the mesonotum are simple on the holotype, and compound on Chan's specimen. The body length of both females is 56mm; full measurements of Chan's specimen are given in table 1.

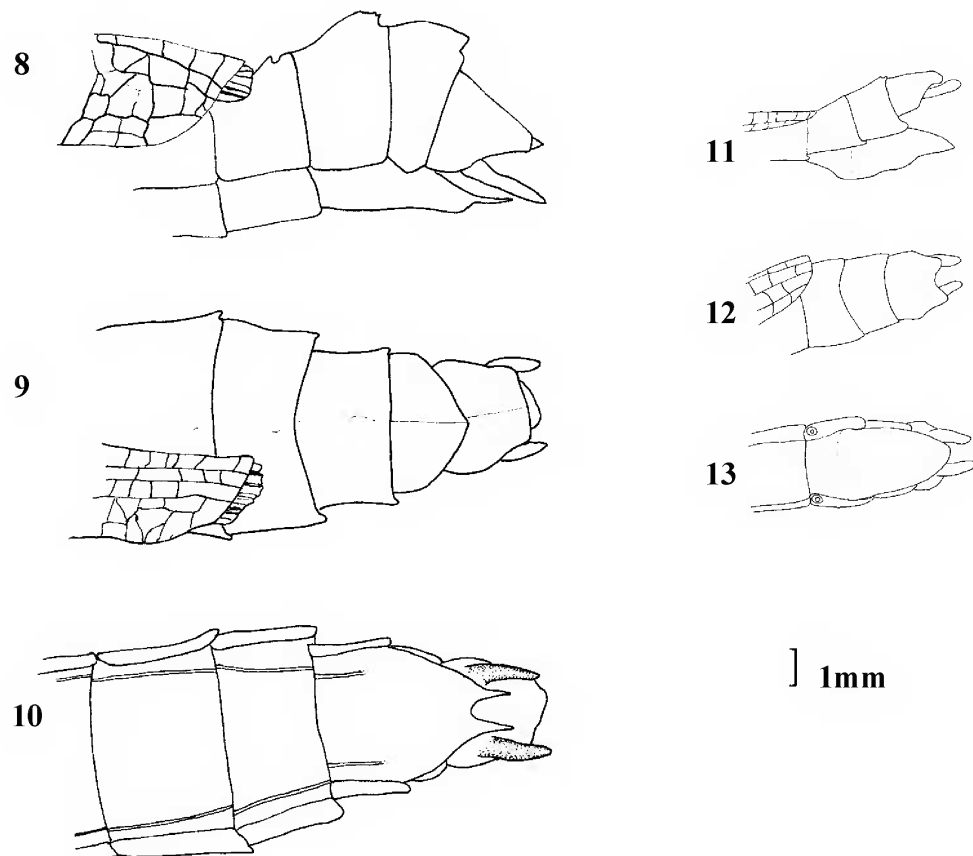
Head, body and legs mid brown, indistinctly mottled with dark brown; fore and hind femora have a dark band at the apex, abdominal tergites 7-10 are predominantly dark brown; many of the spines have dark apices. The head has a clearly defined dark brown triangle between the eyes and there are two triangles of the same colour on the posterior of the mesonotum. The posterior half of the mesonotum has a smooth patch (devoid of granules) of medium to dark brown. Tegmina and costal region of wings are mottled mid brown, dark brown and a sandy-cream colour; there is no distinct pattern to the coloration, for example the left tegmen bears all three colours while the right tegmen is almost uniformly sandy-cream. Anal region of wings translucent, colourless, with brown veins.

Back of the head finely spinose and lobed, lobes are on the elongated swelling at the back of the head; the swelling projects backwards, reaching just beyond the mid point of the pronotum and has a distinct downwards curve (fig 6). Pronotum granulose; suddenly narrowing just behind the anterior margin then gradually widening, anterior and posterior margins about equal width. Mesonotum spinose and granulose; mid point with a swollen mound which bears two compound spines (holotype has two simple spines); posterior margin with a granulose swelling; the area between the two swellings is smooth. Metanotum and abdominal tergites more or less smooth, tergites 6-10 slightly rugulose laterally. Abdominal tergites 6-9 with small lobe on posterior margin, 8-9 are slightly laterally compressed and strongly raised. Anal segment with slight longitudinal carina; apex straight. Cerci visible dorsally, cylindrical. Apex of operculum with such a deep notch that it almost appears to terminate as two spines (fig 10). Pro and mesopleura granulose, metapleura granulose and spinose. Thoracic sternites granulose; abdominal sternites smooth or setulose.



Figures 6-7. *Paraloxopsis korystes*, head and thorax, side view. 6. Female. 7. Male.

Tegmina rugose, leading edge (when folded) very distinctly concave (fig 6). All legs granulose throughout, each with tibiae only slightly shorter than femora. Fore femora compressed and incurving at the base, outward curving at the apex. Hind femora swollen and with a twisted appearance. Hind tibiae reaching to the apex of the abdomen. All femora with indistinct medio-ventral carina at the base, this becomes more distinct and divides into two parallel carinae towards the apex. Medio-ventral carinae spinose apically on fore femora, spinose throughout on mid and hind femora. Hind femur with medio-ventral carina very close to ventro-posterior carina, particularly basally.



Figures 8-13. *Paraloxopsis korystes* abdomens: lateral, dorsal, and ventral views.

8-10. Female. **11-13.** Male.

Male (figs. 5, 7, 11-13)

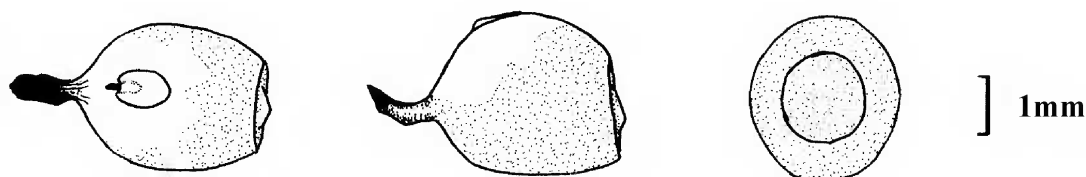
Coloration similar to female but with less sandy-cream present; brown triangles on head and mesonotum less distinct. Body length 43.5-44mm, full measurements of C.L. Chan's specimen are given in table 1; CUMZ nymph 21mm.

Head and pronotum as in female. Mesonotum as in female but median mound has only two simple spines. Abdominal tergites without lobes, otherwise as in female; anal segment with slight longitudinal carina, apex of segment with a rounded notch (fig 12). Thoracic and abdominal sternites, and pleura as in female. Poculum semi-cylindrical, narrowing at the apex to terminate in a blunt triangle (fig 13).

Tegmina as in female. Legs as in female but outward curve of fore femora is almost imperceptible; hind tibiae not quite reaching end of abdomen but tarsi exceeding it; spination and carinae of femora as in female.

Eggs (figs. 14-16)

Capsule almost spherical with ventral side and opercular end flattened, polar end with long, slender stalk; ventral side slightly longer than dorsal. Capsule mid brown antero-dorsally and dark-brown posterior-ventrally and around the operculum. Operculum dark brown, round; with a small, central, conical mound. Micropylar plate white with a red margin, small, oval with a indentation at the polar end, slightly raised. Length (excluding stalk) 3.4mm, height 2.8mm, width 2.6mm, stalk length 1.1mm.



Figures 14-16. Egg of *Paraloopsis korystes*; 14. dorsal, 15. lateral, 16. opercular view.

Paraloopsis tuberculata (Redtenbacher, 1908) n. comb.

Loxopsis tuberculata Redtenbacher, 1908: 503; Bragg, 2001: 565. Syntypes: ♀ (MNHN) Kalimantan, Pontianak. R. Oberthur, 1897; ♂ (MNHN – not traced) Borneo.

Agondasoidea tuberculata; Seow-Choen, 1998: 9, fig (♀).

Loxopsis sp.; Bragg, 2001: 565, figs 225a-c (egg).

[Not *Loxopsis tuberculata* Klante, 1969: 5, fig 1(♂); Klante, 1975: 93. – misidentification.]

Material examined

BRUNEI, Badas.

♀, with 5 eggs (PEB-2300) 01.xi.1994, P.E. Bragg. ♀ (Photograph only – see cover illustration of this publication) 06.iii.1993, Mel Herbert.

KALIMANTAN, Pontianak.

♀ Syntype (MNHN) R. Oberthur, 1897 [photograph only examined].

SABAH, Long Pasia, 900m.

♀ (Kinabalu NP – PH/97/00103) 27.vi.1997, Puis K.

SARAWAK, Serapi.

♀, ♂ (F. Seow-Choen) v.1997, FSC.

SARAWAK, Serapi N.P.

2♂♂, (F. Seow-Choen) xii.1997, FSC.

SARAWAK, Kuching.

♀ (CUMZ) 20.viii.1897; ♀ (SMSM-365) 30.v.1900 [photograph examined].

SARAWAK, Santubong.

♀ (SMSM-366) vii.1925 [photograph examined].

Female (figs 1-3, 17-18, 20-22)

Head, legs and body almost uniformly mid brown, but may be mottled with slightly darker brown. Costal region of wing mid brown with one or two dark brown blotches; rarely, the costal region is uniformly mid brown (PEB-2300 is the only one of eight specimens). The dark blotches vary in shape and may be symmetrical or different on the two wings. Anal region of wings translucent pale brown with brown veins. Body length 54-56mm, full measurements in table 1.

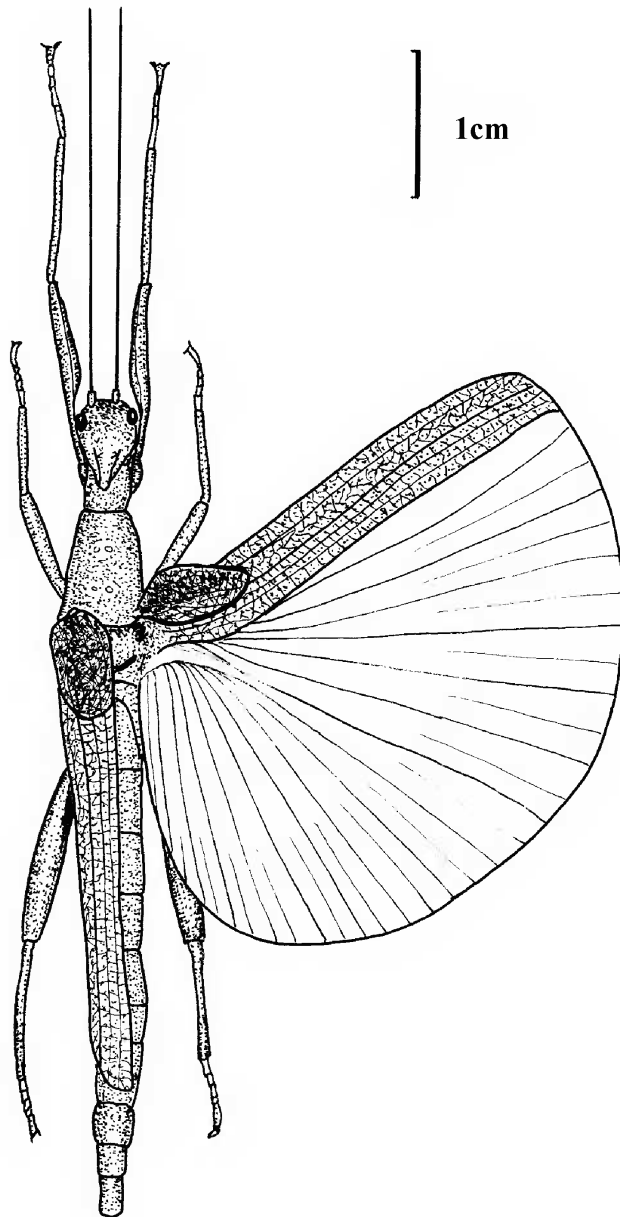
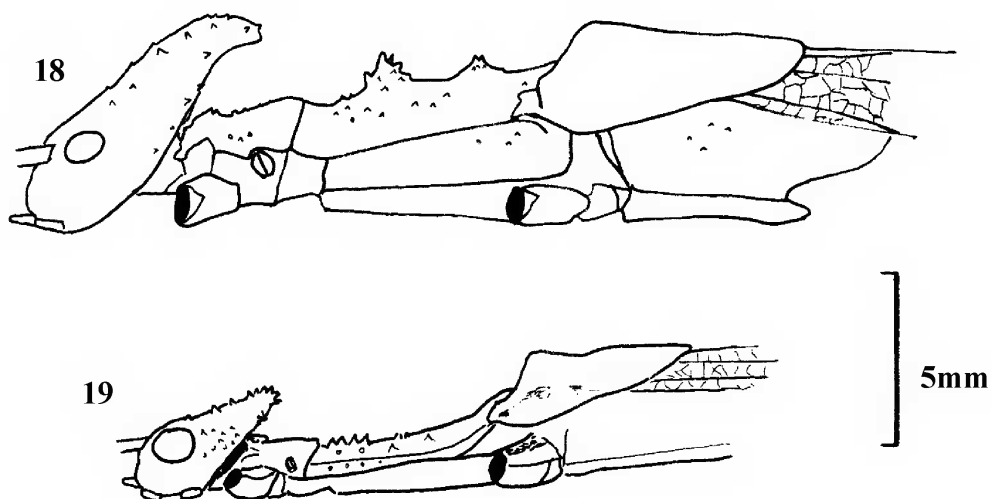


Figure 17.
Paraloxopsis tuberculata, female.

Back of the head spinose but without lobes; the swelling projects backwards, reaching well beyond the mid point of the pronotum, almost to the posterior, and has a distinct downward curve (fig 18). Pronotum granulose; suddenly narrowing just behind the anterior margin then gradually widening, anterior and posterior margins about equal width. Mesonotum roughly granulose; with two swollen mounds, the first is one third from the anterior margin and is bifurcate and bears a few rounded spines, the second is one third from the posterior margin and is bifurcate and granulose but not spinose; posterior margin with a minute granulose swelling. Metanotum and abdominal tergites smooth. Abdominal tergites 8-9 slightly laterally compressed and strongly raised, with a small lobe on the posterior margin. Anal segment with slight longitudinal carina; apex straight or very slightly indented. Cerci cylindrical; visible dorsally only on the specimen with a shrunken abdomen (CUMZ). Apex of operculum with a deep notch (fig 22). Pro-, meso-, and metapleura granulose. Thoracic sternites granulose; abdominal sternites smooth or setulose.



Figures 18-19. *Paraloxopsis tuberculata*, head and thorax: **18.** Female. **19.** Male.

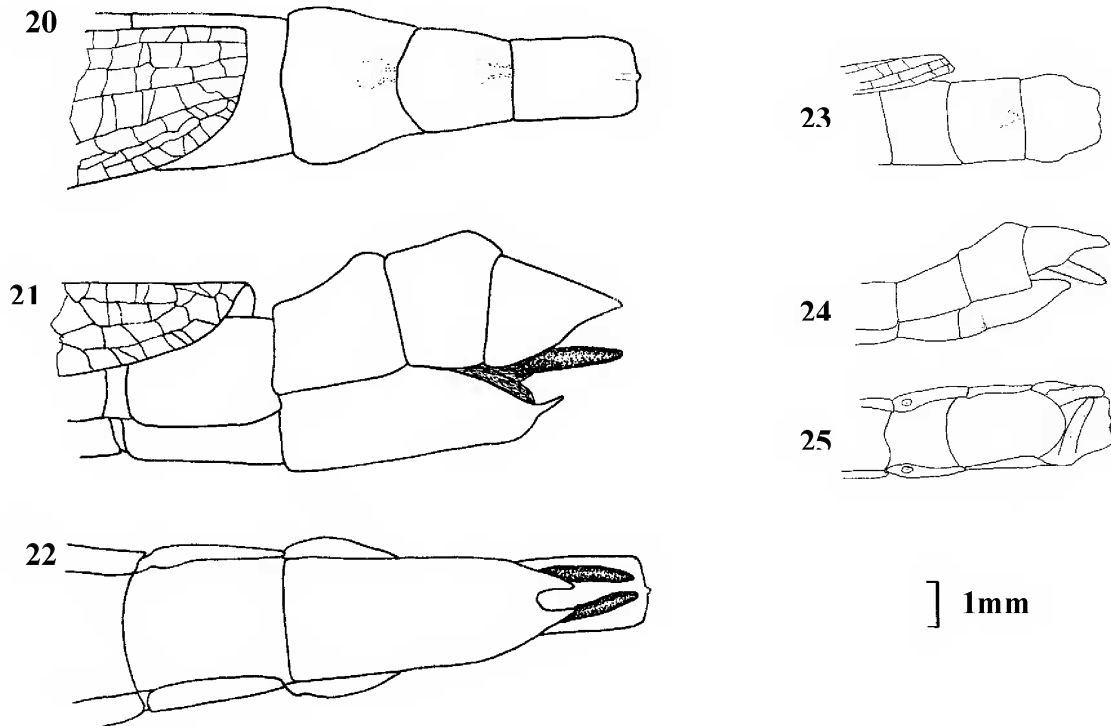
Tegmina rugose, leading edge (when folded) is almost straight (fig 18). All legs granulose throughout, with tibiae slightly shorter than femora. Fore femora compressed and incurving at the base. All femora appear swollen, particularly the fore and hind femora. Hind legs seem to be of variable length compared to the body length: the two specimens from Badas have legs that do not reach the end of the abdomen, the KNP and Seow-Choen's specimens have legs which reach beyond the end of the abdomen: the other specimens are damaged or it is not possible to judge the leg length from the photographs. All femora with indistinct medio-ventral carina at the base, this becomes more distinct and divides into two parallel carinae towards the apex. Medio-ventral carina spinose only apically on fore femora, spinose throughout most of mid and all of hind femur. Hind femur with medio-ventral carina very close to ventro-posterior carina basally.

Male (figs 19, 23-25)

Coloration more variable than female; one specimen mainly mid brown mottled with darker brown and some sandy-cream; two specimens with lighter bodies mottled with mid and dark brown, heads uniformly sandy-cream. Body length 42-44mm; full measurements are given in table 1. Tegmina and costal region of wing darkish brown with numerous greenish-grey blotches.

Back of head spinose and without lobes; swelling reaching no more than half way along the pronotum at most, and not downward curving (fig 19). Pronotum as in female. Mesonotum granulose, with a few enlarged granules or small spines on the anterior; there are no mounds in the middle, only a minute swelling between the bases of the tegmina. Abdominal tergites 1-6 smooth, 7-10 rugulose, 9th with small lobe on posterior margin, anal segment slightly granulose, apex of segment slightly indented (fig 23). Thoracic and abdominal sternites and pleura as in female. Poculum semi-cylindrical, apex rounded (fig 25).

Tegmina as in female. Legs similar to female; distortion of the abdomens makes relative length of back legs difficult to judge; spination and carinae of femora as in female.

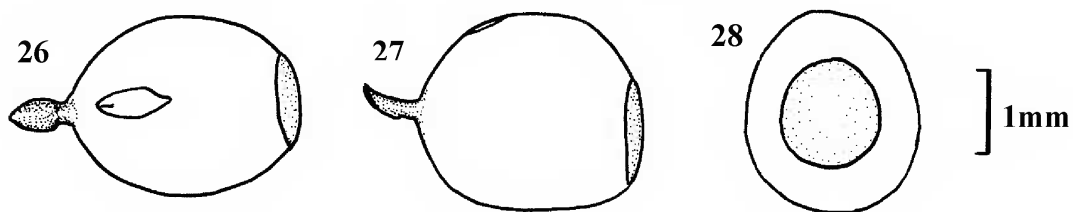


Figures 20-25. *Paraloxopsis tuberculata*, abdomens: lateral, dorsal, and ventral views.
20-22. Female. 23-25. Male.

Eggs (figs 26-28).

Capsule almost spherical with opercular end flattened, polar end with long, slender stalk. Capsule very pale brown with mid-brown blotches around operculum and micropylar plate. Micropylar plate small, diamond shaped, slightly raised. Length (excluding stalk) 2.7mm, height 2.5mm, width 2.2mm, stalk length 0.7mm.

A group of five eggs was laid on one leaf by PEB-2300.



Figures 26-28. Egg of *Paraloxopsis tuberculata*; 26. dorsal, 27. lateral, 28. opercular view.

Comments

The CUMZ specimen bears a label (in Shelford's handwriting?) that reads "*Acridiopus* n.sp. n.g. near *Agondasoidea* Brunner". Mel Herbert (personal communication), also reported finding a male, presumably of this species, at Badas in February 1993, but the specimen was not photographed or preserved. Klante's specimen was labelled as being from the Philippines, although he expressed doubts about this, and his illustration clearly shows that it has a mesothorax about twice as long (compared with the fore wing) as the species illustrated here, it is therefore unlikely that Klante's specimen was *tuberculata*.

Lengths in mm.	<i>P. korystes</i>		<i>P. tuberculata</i>	
	♀	♂	♀	♂
Body length	56	44	(54-)56	42-44
Antennae	33	30	30	23
Head	7	6	7	4
Pronotum	4	2.5	4.5	2.5
Mesonotum	8.5	4.5	8(-7.5)	5.5
Metanotum	6	6	5	?
Median segment	8	3	5	?
Tegmen	8	6	8	5.5
Hind wing	32	30.5	31.5	28.5
Fore femur	14	10	12	11
Fore tibia	13.5	4.5	9.5(-10.5)	6
Fore tarsus	7.5	6	7	6
Mid femur	10	8	8	7
Mid tibia	4.5	7.5	6.5	5
Mid tarsus	5.5	4	4.5	4
Hind femur	16	11	11.5(-13)	11.5
Hind tibia	15	10	9.5(-10)	8
Hind tarsus	8	6	5.5(-6)	5

Table 1. Measurements of *Paraloxopsis* spp.

The measurements in the table are based only on my specimen and those of Francis Seow-Choen, measurements were not taken from photographs, the KNP specimen was not measured at the time of examination; the CUMZ female was omitted since it clearly has a shrunken abdomen, originally it would have been of similar size to the other specimens. The table gives the longest and shortest body length for each sex, and full measurements of the longest specimens; the figures for the female in brackets are for Seow-Choen's specimen, which has relatively longer fore and hind legs.

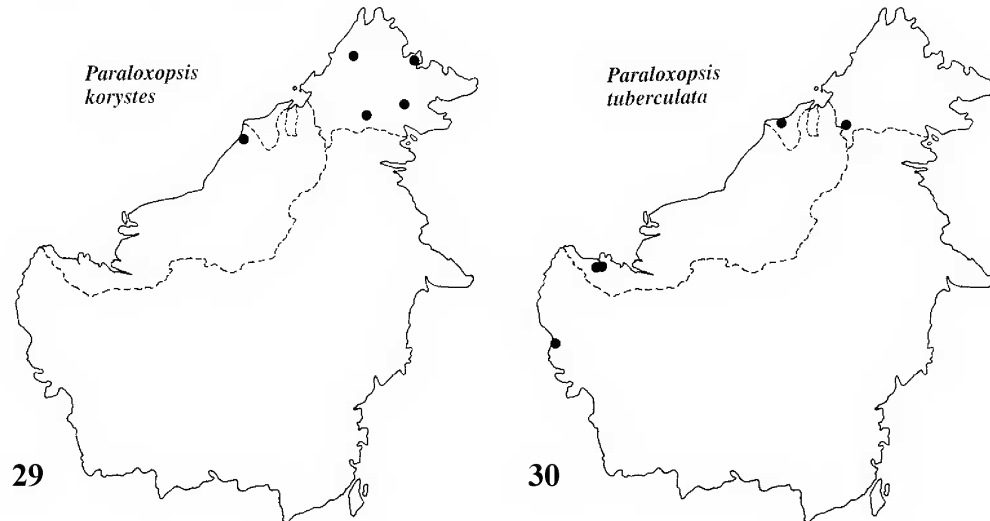
Discussion

The eggs of the two species in this genus are highly specialised, as are those of several species of *Asceles* (e.g. *inquinatus* Redtenbacher, *larunda* (Westwood), *margaritatus* Redtenbacher, *malaccae* (Saussure), *moricula* (Redtenbacher), *tanarata* Brock, *singapura* Brock & Seow-Choen, and an unidentified Bornean species in my collection). The eggs (figs 14-16 & 26-28) are pinned to leaves by the polar spine (see Sellick, 1993, figure 1). The females of both genera have a deeply notched operculum. Such an unusual method of egg laying is unlikely to have developed independently and must be considered as evidence for a close relationship between the genera exhibiting this characteristic.

On the basis of adult morphology, *Loxopsis* and *Paraloxopsis* must be very closely related. I have found eggs similar to those of *Paraloxopsis* in an area of Kalimantan where I collected two males of *Loxopsis*. Since *Loxopsis* are usually comparatively rare in Borneo,

finding two in one area suggests they were common at that locality, in addition the area had few phasmid species present, so the chance that the eggs are from *Loxopsis* is correspondingly high. This suggests the eggs of the two genera are also very similar.

Paraloxopsis tuberculata has quite a wide distribution (see fig 30) while *korystes* appears more restricted (fig 29). At least three of the specimens of *tuberculata* were collected in an area of peat swamp, as were two of four Bornean members of *Loxopsis* in my collection. The mode of egg laying is particularly suited for peat swamps where eggs dropped to the ground would be in danger of becoming water-logged.



Figures 29-30. Distribution of *Paraloxopsis* spp. in Borneo.

Acknowledgements

I am grateful to Oliver Zompro for providing the photograph of the type specimen of *Loxopsis tuberculata*; to Mel Herbert, and Robert Junker for their photographs. Thanks are due to C.L. Chan, F. Seow-Choen, and staff at CUMZ for the loan of material. My thanks to staff at ZMUH for granting access to the collection. Charles Leh of SMSM kindly allowed me to photograph the collection several years ago when I was cataloguing the collection. Lastly, thanks to staff at Kinabalu Park Conservation Centre for permission to photograph specimens during my visit in 2001.

References

- Arnett, R.H., Samuelson, G.A. & Nishida, G.M. (1993) *The insect and spider collections of the world*. [second edition] Sandhill Crane Press, Gainesville, Florida. [Available on-line at <http://hbs.bishopmuseum.org/codens/>]
- Bragg, P.E. (2001) *Phasmids of Borneo*, Natural History Publications (Borneo), Kota Kinabalu.
- Günther, C. (1932) Phasmoiden des Kina Balu auf Borneo, aus dem Hamburger Zool. Museum. *Wiener Entomologische Zeitung*, **49**(4): 313-320.
- Klante, H. (1969) Weitere Stabheuschrecken (Insecta, Phasmatoptera) aus dem Naturkundemuseum Görlitz. *Abhandlungen und Berichte des Naturkundemuseums Görlitz*, **44**(7): 1-12.
- Klante, H. (1975) Revision der geflügelten Kegelkopf-Stabheuschrecken von Borneo aus der Gattung *Loxopsis* Westw. (Insecta: Orthoptera, Phasmatoptera). *Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin*, (N.F.) **15**: 84-102.
- Redtenbacher, J. (1908) *Die Insektenfamilie der Phasmiden*. Vol. 3. Leipzig.
- Sellick, J.T.C. (1993) The leaf-piercing eggs of *Asceles*. *Phasmid Studies*, **2**(2): 54-55.
- Seow-Choen, F. (1998) Crown and jewels of the forest: A study of phasmid heads. *Singapore Scientist*, **84**: 6-9.
- Zompro, O. (2002) Catalogue of type material of the insect order Phasmatodea at the Zoologisches Museum der Universität Hamburg (Insecta: Orthoptera: Phasmatodea). *Mitteilungen Hamburgisches Zoologisches Museum und Institut*, **99**: 179-201.